AMENDMENTS TO THE SPECIFICATION:

Please insert prior to the paragraph beginning on line 12, page 1 the following heading:

Field of the Invention

Please insert prior to the paragraph beginning on line 19, page 1 the following heading:

Background and Summary

Please replace the paragraph beginning on line 19, page 1 with the following:

The faultless functioning of the display is of major significance in many applications. Defects in the measuring value display of medical-technological devices, e.g. blood sugar monitoring devices, can lead to incorrect readings and may ~~cause~~provide life-threatening misinformation [[of]]to the user, for example ~~due to ensuing~~by providing incorrect dosing of a medication, and bring about life-threatening situations.

Please replace the paragraph beginning on line 1, page 2 with the following:

In battery-operated devices, in particular, liquid crystal displays (LCDs) have all but displaced all other displays, since their electrical power needs are low, ~~since~~ they can be operated at low operating voltages, their electronic triggering is easy to implement, they provide high contrast and image quality, the shape of the display segments can be designed virtually without limitations using simple lithographic procedures, whereby even large-area segments or displays can be implemented, they have a low overall depth, and are easy to install. LCD displays of this type comprise multiple segments that can be activated individually, whereby a segment displays a character or a symbol or part of a character or ~~signal~~symbol.

Please replace the paragraph beginning on line 22, page 3 with the following:

In the document, WO 95/14238, the test of the functional performance of the LCD segments is based on their intrinsic capacitance as the parameter being measured. Any change is used to conclude that there is a failure. The LCDs are operated with alternating voltage and the operating current is what is measured. A special feature of the functional test is that the current is measured at various operating frequencies and tested whether or

not the current is within predetermined limits of a range in a certain frequency range. This allows various conclusions to be drawn with regard to different states and causes of failure.

Please replace the paragraph beginning on line 33, page 5 with the following:

Taking the prior art as described above into consideration, the invention ~~is based on the object to~~ provides a method and a corresponding electronic measuring system for testing the function of LCD displays that allows for reliable, user-independent, fully automatic functional testing, whereby the method is to be implemented with little effort, for example by means of CMOS technology in an ASIC.

Please delete the paragraph beginning on line 7, page 6:

~~This object is achieved according to the invention by a method and/or a device with the features of the appended independent patent claims. Preferred embodiments and developments of the invention are evident from the dependent patent claims and the following description in conjunction with the corresponding drawings.~~

Please replace the paragraph beginning on line 14, page 6 with the following:

[[An]]One embodiment according to the invention for testing the function of LCD displays comprising individual display segments, on the basis of the difference in the electrical capacitance of defective and intact display segments thus comprises the particularity that, instead of measuring an electrical measuring parameter that is dependent on the capacitance of the display segments and comparing the measuring value thus measured to a reference value, the capacitance of the display segments is determined directly with a capacitance measuring method by measuring the electrical charge stored in the display segment.

Please replace the paragraph beginning on line 27, page 6 with the following:

In the context of the present invention it was ~~surprisingly~~ found that the charge stored in LCD display segments can be measured such that it becomes feasible to directly determine the capacitance of the display segments at high resolution and accuracy.

Please replace the paragraph beginning on line 33, page 6 with following paragraph:

The direct determination of the capacitance of LCD display segments according to the invention can be performed in a large number of ways. According to a first ~~advantageous~~ feature ~~it is being proposed to determine~~ the capacitance of the display segments is determined by means of charges transferred by capacitive coupling, whereby an electrical measuring current is coupled capacitively via the capacitance of the display segment to be measured into an evaluation circuit and the evaluation circuit measures the charge coupled over. Herein, according to an additional preferred feature, the measuring current can be provided in the form of an alternating current and in that the charge coupled over per alternating voltage period is measured, from which results the capacitance of the display segment provided the frequency is known.

Please replace the paragraph beginning on line 14, page 7 with the following:

According to another ~~preferred~~ feature ~~it is proposed to measure~~ the capacitance of the display segments is measured with a capacitance measuring method, in which a charge transfer controlled by a sequence control proceeds through both the capacitance of a display segment to be measured and a reference capacitor, and the capacitance of the display segment is determined by means of a charge balance between the display segment to be tested and the reference capacitor.

Please replace the paragraph beginning on line 24, page 7 with the following:

A relative measurement of this type based on the determination of a ratio of capacitances ~~is advantageous in that it is insensitive~~has decreased sensitivity to temperature and long-term drifts, e.g. of the reference voltage sources, ~~and/or~~ in that it compensates these drifts. In this context, ~~a preferred~~one embodiment provides, for minimization of measuring errors, the reference capacitor integrated into the LCD display, for example in the form of an LCD segment or capacitor component. This ~~is advantageous in that it~~further compensates for temperature drifts~~ even better~~.

Please replace the paragraph beginning on line 1, page 8 with the following:

~~A preferred~~An embodiment of the method according to the invention consists of the determination of the capacitance of the display segments by means of a capacitance measuring method utilizing a $\Delta\Sigma$ conversion. A method of this type is particularly suitable

for measuring small capacitances. The capacitance of LCD display segments is approx. 1 pF bis 300 pF such that the charges to be measured are on the order of pC and the measuring currents are on the order of pA and thus are technically difficult to detect.

Please replace the paragraph beginning on line 12, page 8 with the following:

A capacitance measuring method utilizing a ΔΣ_conversion can be set-up with scarce use of analog electronics and at high measuring accuracy and insensitivity to parasitic scatter capacitances, for example, in the form of a first order ΔΣ converter, i.e. by using an integrator.

Please replace the paragraph beginning on line 10, page 9 with the following:

The result of a conversion of this type is a 1-bit data stream whose mean density of ones is proportional to the capacitance to be measured. This data stream is then processed adequately to obtain a multi-bit event. This is typically done by means of digital filters, so-called decimation filters. According to the theory of ΔΣ converters, for analysis of a data stream of a "charge balancing" converter of a given order, in general, a decimation filter of an order higher by at least one is required. Accordingly, ~~the preferred~~in one embodiment of the invention, a first order ΔΣ converter uses a decimation filter of second or higher order.

Please replace the paragraph beginning on line 23, page 9 with the following:

A control circuit for controlling the constant charge balance of the ΔΣ converter can be set up [[from]]using a few flip-flops and easily integrated into an ASIC. The structure of a second order decimation filter is very regular and easy to integrate into an ASIC. In other embodiments, implementation of the filter in a microcontroller, for example in the microcontroller of the sequence control, is also feasible.

Please replace the paragraph beginning on line 32, page 9 with the following:

According to another ~~preferred~~ feature ~~it is proposed to use~~ an automatic measuring-circuit selector [[to]]addresses individual display segments for the functional test. ~~The particular advantage of~~As the measuring-circuit selector ~~selecting~~selects individual segments, ~~is its capacity to~~it strongly reduces or all but excludes the influence of parasitic capacitances and coupling capacitances which usually falsify the measuring result.

Please replace the paragraph beginning on line 6, page 10 with the following:

In ~~an advantageous~~another embodiment it can be provided that the measuring-circuit selector is used to apply a measuring voltage to a first electrode of a display segment to be tested, to connect the electrodes of other display segments corresponding to said first electrode to earth in terms of alternating voltage, to measure the coupled charge on the second electrode of the display segment to be tested, whereby this point is connected to virtual earth in terms of alternating voltage, and to connect the electrodes of other display segments corresponding to said second electrode to earth in terms of alternating voltage.

Please replace the paragraph beginning on line 19, page 10 with the following:

~~It is particularly preferred for~~According to one variation, the first electrode to be the front electrode and the second electrode to be the back electrode of the display segment to be tested.

Please replace the paragraph beginning on line 23, page 10 with the following:

~~Advantageously, t~~The method according to the invention can also be used when the display segments are triggered in a matrix structure using the multiplex procedure both for the ongoing operation of the LCD display and the functional test.

Please replace the paragraph beginning on line 29, page 10 with the following:

According to another ~~advantageous~~ feature it is proposed to select the triggering levels and clock phases for triggering the display segments, in particular in a multiplex procedure, such that the voltage level of the inactive display segments is below the response threshold and the voltage level of the active display segments is above the response threshold of the display segments, to perform the capacitance measuring method using these voltage levels, and to synchronize the switch phases of the capacitance measuring method with the clock phases of LCD triggering.

Please replace the paragraph beginning on line 6, page 11 with the following:

For the operation of the LCD display segments~~, it is advantageous for~~ the display segments [[to]]may be triggered direct voltage-free, on average, by means of periodical reversal of the polarity of the voltage levels. This is because in direct voltage operation or in the

presence of a fraction of direct voltage there is a risk of electrolytic effects occurring due to leakage currents, which may decompose the liquid crystals. Moreover, it is advantageous for the capacitance measuring method to be performed such that the effective voltage value of the display segment is identical to the value without measurement of the capacitance.

Please replace the paragraph beginning on line 19, page 11 with the following:

Moreover, it is ~~advantageously~~ provided that the capacitance of a display segment is measured during a clock phase of display segment triggering, whereby multiple switching processes of the capacitance measuring method are performed within this clock phase.

Please replace the paragraph beginning on line 25, page 11 with the following:

According to another ~~preferred~~ feature it is proposed to trigger the LCD display for the ongoing operation and/or capacitance measurement at low impedance in order to reduce the influence of coupling capacitances.

Please replace the paragraph beginning on line 30, page 11 with the following:

~~A particular advantage~~Another feature of the method according to the invention ~~can be~~is that the capacitance of the display segments [[is]]may be determined by means of the capacitance measuring method in the form of a digital measuring result and the functional test of a display segment is performed using the digital measuring result.

Please replace the paragraph beginning on line 2, page 12 with the following:

Another ~~advantageous~~ feature of the method according to the invention is that it is possible to perform the functional test of a display segment during the ongoing operation of the LCD display. An ~~advantageous~~ embodiment of the method according to the invention provides for only activated display segments to be tested for function, since non-activated display segments do not yield an incorrect display if malfunctioning. This allows to speed up the functional test of the LCD display segments or to repeat them at a higher frequency.

Please replace the paragraph beginning on line 13, page 12 with the following:

According to an additional ~~advantageous~~ feature the sequence control for the capacitance measurement and/or the measuring-circuit selector for addressing a display segment is modulated by and/or synchronized with the driver circuit of the LCD display.

Please replace the paragraph beginning on line 19, page 12 with the following:

Another ~~advantageous~~ feature can be that one or multiple components of the LCD test facility comprising the sequence control for capacitance measurement, the measuring-circuit selector for addressing of a display segment, the measuring circuit (analog switch, integration amplifier, and comparator and integration capacitor, if any), the LCD driver/decoder circuit, and the evaluation circuit (microcontroller) are housed in a single integrated component, e.g. an ASIC or a mixed signal FPGA. In a particular embodiment thereof, an LCD triggering circuit as usually employed for driving and decoding can be provided with the LCD testing facility according to the invention. In this context, ~~a preferred embodiment provides for~~ the ASIC [[to]]<u>can</u> be integrated into an LCD driver circuit.

Please replace the paragraph beginning on line 5, page 13 with the following:

The invention and its particular embodiments ~~comprise a multitude of advantages. They~~ provide a digital measuring result allowing high accuracy and therefore reliable testing to be achieved. This allows the criteria for proper functioning and/or the presence of malfunction in the functional test to be selected in a very differentiated fashion, and to be analyzed by software. In the case of the relative measurement, insensitivity to temperature and long-term drifts is achieved. Moreover, series resistances, for example in the contacts, have no <u>appreciable</u> impact on the measuring result provided the switching periods are sufficiently long. The method according to the invention is suitable for any LCDs, i.e. it is not restricted to those with a common back electrode or with separate segment and back electrodes, but also suitable for LCDs with segment electrodes in a matrix structure.

Please replace the paragraph beginning on line 11, page 14 with the following:

The method according to the invention can be performed very fast. A typical LCD display can be tested completely in approx. 0.5 to 1 second, including multiple scanning to improve the reliability of the result. The method can work with a constant measuring

frequency and segment testing can be performed in a direct voltage-free fashion. ~~As another advantage, t~~The circuit according to the invention can be implemented at very low cost, in particular when it is integrated into the ASIC for triggering the LCD display.

Please insert prior to the paragraph beginning on line 11, page 15 the following heading:

Brief Description of the Drawings

Please replace the following Brief Descriptions of the Drawings beginning on line 24, page 15 through line 15, page 16 with the following:

Fig. 7	shows the 2x2 matrix of [[f]]Fig. 6 in two-terminal view;
Fig. 8	shows the matrix of [[f]]Fig. 7 including the elimination of the influence of parasitic capacitances in the functional test;
Fig. 9	shows the display segments of the LCD matrix of [[f]]Fig. 6;
Fig. 10	shows LCD triggering impulses for [[f]]Fig. 9;
Fig. 11	shows an LCD driver circuit for the multiplex operation of [[f]]Fig. 6;
Fig. 12	shows the LCD driver circuit of [[f]]Fig. 11 with $\Delta\Sigma$ conversion according to the invention, for the testing of display segments;
Fig. 13	shows a modified capacitance measuring circuit at rest;
Fig. 14	shows the capacitance measuring circuit of [[f]]Fig. 13 in its charging phase and comparison phase;
Fig. 15	shows the capacitance measuring circuit of [[f]]Fig. 13 in the comparison phase without reference integration; and
Fig. 16	shows the capacitance measuring circuit of [[f]]Fig. 13 in the integration phase with reference integration.

Please insert prior to the paragraph beginning on line 17, page 16 the following heading:

Detailed Description of the Invention

Please insert the following paragraph prior to the paragraph beginning on line 17, page 16 with the following:

<u>While the invention is susceptible to various modifications and alternative forms, exemplary embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.</u>

Please replace the paragraph beginning on line 17, page 16 with the following:

Fig. 1 shows a functional diagram of an electronic measuring system according to the document, WO 95/14238<u>, the disclosure of which is expressly incorporated by reference herein,</u> for the testing of LCD displays. The circuit cooperates with common driver ICs of the LCD triggering and comprises two switches S1 and S2, one inverter 1, and one voltage source U. During a specific test mode, the flow of current through the LCD segment to be tested, illustrated by the capacitance Cseg, is guided through a shunt resistor RS. The voltage drop at this shunt resistor RS is amplified by means of amplifier V and stored for the time being in a sample and hold element (S&H). A comparator Δ compares the output voltage of the sample and hold element to a reference voltage Uref and feeds the result of the comparison to the microprocessor μP that switches the switches S1 and S2 periodically. The microprocessor μP changes the keying frequency until the comparator signal shows pronounced signal changes (jitter). The frequency at which this event occurs is then used to deduce the capacitance Cseg of the display segment tested.

Please replace the paragraph beginning on line 18, page 18 with the following:

Fig. 4 shows a schematic diagram of a preferred measuring arrangement according to the invention for determining the capacitance Cseg of an LCD display segment based on a ΔΣ capacitance measuring method that is also called ΔΣ conversion. In principle, this corresponds to a charge pump. The segment capacitance Cseg to be determined and a reference capacitor Cref whose capacitance is known are integrated in a switch/capacitor structure according to [[f]]<u>F</u>ig. 4. The measuring arrangement comprises switches Sa, Sb, Sc, Sd and a downstream integrator Σ with integration capacitor C5 and downstream comparator Δ. The integration capacitor C5 should be selected sufficiently large to ensure

that the integrator Σ does not reach its limits at the maximal segment capacitance Cseg to be expected and given recharging voltage swing ± Uref.

Please replace the paragraph beginning on line 13, page 21 with the following:

Fig. 7 shows a two-terminal representation of the 2x2 matrix of [[f]]Fig. 6. The capacitance C11 is to be measured in an example, i.e. the ΔΣ converter is placed between the lines, SEG1 and COM1. The current Iv denotes the current flowing into the integrator, i.e. into the virtual mass. The two-terminal representation of [[f]]Fig. 7 shows that not only the capacitance C11 to be measured contributes to the current Iv, but also the bridge circuit formed by the other capacitances shown in the circuit. This would falsify the measuring result.

Please replace the paragraph beginning on line 24, page 21 with the following:

The problem can be solved by using a measuring-circuit selector that connects all other lines of the matrix, i.e. the lines SEG2 and COM2 in this example, to earth as shown in [[f]]Fig. 8. As a consequence, the parasitic current flows off towards earth and does not contribute to the current Iv and/or the measuring result. A corresponding procedure is also feasible with larger matrices, such as the matrix shown in [[f]]Fig. 5.

Please replace the paragraph beginning on line 33, page 21 with the following:

The LCD shown in [[f]]Fig. 5 consists of a matrix of many mutually coupling capacitances. If one wished to measure, for example, the capacitance of the segment C35 on the electrodes COM3 and SEG5, one would not measure just the capacitance C35 alone, but the other LCD capacitances as well due to the existing connections. This falsifies the measurement. In contrast, through the use of a measuring-circuit selector it becomes feasible to measure one certain capacitance, e.g. C35, in an isolated fashion, by ensuring through the use of the measuring-circuit selector that any currents flowing through capacitances other than the capacitance to be measured do not contribute to the capacitance measurement.

Please replace the paragraph beginning on line 2, page 23 with the following:

If, for example, the segment capacitance C35 in [[f]]Fig. 5 is to be measured, the alternating voltage is applied at SEG5. The terminal connections SEG1 to SEG4 and SEG6

to SEG9 are connected to earth. As a consequence, there is essentially no influence of any of the parasitic capacitances between neighboring segment electrodes CS12...CS89 or between not directly neighboring segment electrodes. Although these capacitances cause a somewhat stronger draw on the applied alternating voltage; the fault current flows off toward earth. The flow of current into the virtual earth is measured at electrode COM3 and used to determine the capacitance C35. The electrodes COM1, COM2, and COM4 are connected to earth such that no cross-currents can flow in the coupling capacitances between the back electrodes CC12...CC34. Consequently, CC12...CC34 have no effect on the measurement.

Please replace the paragraph beginning on line 19, page 23 with the following:

With the exception of C35, all other segment capacities C11...C49 have no influence on the measurement, since the ~~circuiting~~circuitry described above including the measuring-circuit selector connects all segment capacitances other than C15, C25, C35, and C45, to earth or virtual earth on both sides such that no current flows through these elements. The currents flowing through C15, C25, and C45 flow off towards earth and thus do not contribute to the capacitance measurement either. Taken together, the LCD ~~circuiting~~circuitry described above including a measuring-circuit selector allows for measurement of individual LCD segments in the matrix.

Please replace the paragraph beginning on line 32, page 23 with the following:

A measuring-circuit selector of this type preferably consists of digitally triggered analog multiplexers in a mixed CMOS-Schottky diode switch technology. Provided the distance to the LCD to be measured is kept short, these possess only negligible inherent parasitic capacitance. In the case depicted in [[f]]Fig. 6, a measuring-circuit selector has nine positions, for example for coupling-in of the stimulus, and five positions for measuring the charge, four of which are for the terminal connections COM1 to COM4, and one position is for connecting the calibration or reference capacitor, that is supplied with the stimulus on its other end at all times.

Please replace the paragraph beginning on line 32, page 24 with the following:

LCD displays whose segment and back electrodes are arranged in the form of a matrix are addressed in time-division multiplex operation, since it is not possible to select all

segments concomitantly. In this context, inactive segments cannot be triggered absolutely free of voltage due to the matrix structure. This is illustrated in [[f]]Figures 9 and 10.

Please replace the paragraph beginning on line 5, page 25 with the following:

Fig. 9 shows four display segments 2, 3, 4, and 5 arranged in an exemplary fashion in a square arrangement of square display segments. Segment 2 is activated (black), which means it displays a black square, whereas segments 3, 4, and 5 are not activated (white). The display segments, 2, 3, 4, 5, are triggered electrically in the form of a matrix according to [[f]]Fig. 6.

Please replace the paragraph beginning on line 13, page 25 with the following:

Figures 6 and 7 show that a flow of current through one of the capacitances, C12, C21 or C22, always occurs even upon variation of the voltage levels at COM2 or SEG2. In practical application, this problem is solved by adequate triggering of the trigger voltage level and clock phases such that the voltage level on inactive segments is below the response threshold and the voltage level on active segments is above the response threshold of the liquid crystals. A common multiplex triggering of this type by means of a common LCD driver IC for the LCD of [[f]]Fig. 9 is shown in [[f]]Fig. 10.

Please replace the paragraph beginning on line 25, page 25 with the following:

As shown in [[f]]Fig. 10, ternary signals are applied to the COM electrodes, which each can assume voltage values of 0, 0.5_Ur or Ur. Binary signals assuming one of the voltage values, XUr or (1-X)Ur, are applied to each of the SEG electrodes. The coefficient X, with $0 < X < 0.5$, is selected such that the voltage level required for activation of an LCD segment is established only at maximal resulting voltage excursion, i.e. at the two level combinations Ur, $(1 - X)$Ur and 0, XUr. Periodical reversal of the polarity, shown in [[f]]Fig. 10 by the vertical dashed line, is used to achieve triggering that is direct voltage-free on average. An LCD driver circuit meeting these requirements is shown schematically in [[f]]Fig. 11.

Please replace the paragraph beginning on line 13, page 26 with the following:

The trigger frequency of an LCD display usually is between 30 and 100 Hz. The measuring frequency of a capacitance measuring method according to the invention, of a $\Delta\Sigma$ converter

for example, preferably is higher than 2 kHz, preferably is higher than 5 kHz, and particularly preferably is higher than 10 kHz. Accordingly, a sufficient number of ΔΣ converter switching processes can be made in the LCD trigger clock phases of LCD triggering to allow the capacitance measurement and therefore the functional test to be performed while display is ongoing. In this context, ~~it is advantageous to perform~~ functional testing may be performed such that the effective values of the LCD segment voltages are the same as in the absence of the functional test in order for there to be no difference between the display with ongoing functional testing and the display without functional testing.

Please replace the paragraph beginning on line 30, page 26 with the following:

Fig. 12 shows a corresponding LCD driver circuit with integrated ΔΣ converter. The voltages on the COM terminal connections are constantly sampled at the measuring clock speed of the ΔΣ converter. The voltage, U0, is then to be selected such that the effective value of the segment voltage becomes identical to Ur. According to the example shown in [[f]]Figs. 9 and 10, voltage Ur and coefficient X introduced therein depend on the LCD response threshold. The additional modulation of the LCD triggering voltage by the measuring clock rate causes a reduction in the effective value of the trigger level which is the significant parameter for LCD activation. Therefore voltage U0 is always to be selected larger than voltage Ur depending on the pulse/pause ratio of the measuring clock rate. In the circuit shown in [[f]]Fig. 12, a capacitance measurement is performed only at UCOM=U0 in order to avoid the additional circuitry.

Please replace the paragraph beginning on line 13, page 27 with the following:

In the circuit according to [[f]]Fig. 12, a complete switching cycle consists of three consecutive main phases, namely a charge phase, a comparison phase, and an integration phase. Moreover, there is a resting phase, in which all MOS switches are open. For each complete switching cycle, a single bit is obtained as an intermediary result. A large number of switching cycles of this type is required for a complete capacitance measurement on one LCD display segment. The capacitance is calculated from the sequence of single bits (the intermediary results) per switching cycle. The states of the switches, S1-S11, in fig. 12 in various operating phases are identified in the following table.